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ABSTRACT

The first (exploratory) phase of the Learning in Science Project focused on science teaching/learning in the Form 1 to 4 level (ages 0 to 14) and sought to identify problems and difficulties in several areas. Provided in this paper are comments obtained during structured/unstructured interviews (from students, ex-students, teachers, headmasters, science advisers, and inspectors) and observations made by project staff related to problems/difficulties with science topics (or aspects of science topics) of the Form 1-4 science syllabus. The intent of presenting these comments/observations is not primarily to provide a balanced view of good and bad aspects for Form 1 to 4 science, but rather to open up problem issues as project staff and others see them. Comments/observations focus on topics in general, considering difficulties involving concepts, language/mathematics skills, time, and resources and/or conditions. Additional comments/observations related to difficulties in biology, physics (radiant energy, forces/force, motion/mass, electrical energy, astronomy), and chemistry (matter, mixtures), are presented in an appendix. Three questions are posed based on the comments/observations. Questions consider whether particular problem topics, aspects of topics which are a problem, or themes which occur over a number of topics should be identified and studied. (JN)

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FOCUS ON TOPICS

A WORKING PAPER OF THE LEARNING IN SCIENCE PROJECT

Ross Tasker, Peter Freyberg and Roger Osborne

August 1979

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This is one of a set of discussion papers which focus on various aspects of Form 1-4 Science. The paper collates comments and observations, related to the topic of focus, which were obtained during the first phase of the Learning in Science Project. In this phase we were particularly concerned about problems and difficulties in Form 1-4 Science and because of this the paper is biassed toward issues as identified by pupils, ex-pupils, teachers, headmasters, science advisers, inspectors as well as by our own observers. Our intention in writing the discussion papers is therefore not primarily to provide a balanced view of the good and bad aspects of Form 1-4 Science but rather to open up problem issues as we and others see them, to a limited but wider audience than the project team.

It is our hope that our chosen readers will be prepared to talk to us about the topic under focus in this paper in terms of the following questions:

(i) Are the issues we have raised important and central issues which are of general concern?

(ii) Are there other more basic issues, or other subsidiary questions, about the topic which we have overlooked?

(iii) Which aspects of the topic could we profitably analyze further in the in-depth phase of the project?

(iv) What possible solutions to some of the issues raised could profitably be the subject of further study?

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1.0 INTRODUCTION

This paper looks at problems and difficulties with topics, or aspects of topics, of the F1-4 Science syllabus.

Topics or aspects of topics present problems for many and varied reasons. Therefore any attempt to differentiate between them must be in terms of the specific aspect of teaching and learning we are focusing on at the time.

A topic may be a problem because of

1. difficulties of learning the concepts involved - e.g. the concepts may be too abstract;
2. difficulties in teaching the topic in a relevant and interesting way;
3. difficulties with the language skills, process skills and/or mathematical skills required for understanding;
4. difficulties with respect to the resources, time and/or conditions required to achieve topic objectives.

There is also the question 'for whom is the topic difficult?' A topic considered as difficult by one teacher may not be classed as such by another teacher. Compare these comments from two experienced teachers in the same Intermediate school.

39/7/1 "Most teachers enjoy the electrical energy [topic]"...

38/12/1 "Electrical energy...you've sort of got to have some background - you've got to have some preparation I suppose. I think that a lot of the kids that I've taught have found it very hard to grasp those concepts with electrical energy".

Similarly, a topic creating problems for one pupil can be straightforward for another.

Contrast these comments by two ex-pupils.

43/4/2 "It was too hard to understand - all those shortened bits [chemical symbols etc] for words. You can't remember the, or anything like that".

74/4/3 "The periodic table and ionisation...I went through and learned it pretty easy".

Thus topic difficulty can also be categorised as a function of:

1. teacher background and/or teacher ability;
2. pupil background and/or pupil ability.

The situation is further compounded on occasions, by other factors:

(a) Teacher and pupils might have a quite different perception of a topic

A school we visited was using the ASEP unit - Mice and Men - with its third form. A very experienced teacher made the following comment

17/2/2 "That has proved to me, a very conservative, very traditional teacher, as probably being the most exciting programme of science teaching that I've ever enjoyed".

Two very able girls when asked to comment on this unit replied "we [just] learned how to clean out the cage".

(b) Teachers may have a problem with a topic but be unaware of it.

Our observers have noted instances where misconceptions are being taught as a result of lack of understanding by the teacher, e.g. Intermediate teacher reviewing Biotic Communities:

Teacher: "Who can remember the difference between a population and a community?"

27/2/2 Pupil: "A community is a sub-set of a population".

Teacher: "Right, good boy, that's a good way of saying it"

and later in the same lesson on adaptive features

Teacher: "Right, now there's a word to describe what's happened to these two spiders. They've done something - you do it all the time - if you get a different teacher coming into the room you do this. You have to do it because it's a different circumstance and your working under a different thing".

27/4/3

Pupil: "You adapt".

Teacher: "You adapt - good".

(c) Some teachers don't have a problem with a topic because they no longer include it in their programme.

27/4/1 "When it was going to get difficult last year I remember just at the last minute I swapped over and I did another topic - I think actually I did weather - I was actually going to be doing the solar system".

[Intermediate teacher]

or omit those aspects of a topic which create problems

23/13/2 "I've given up teaching that in the 4-Form really - bonding, electron orbits, shells, moles even - I wouldn't touch them any more".

[secondary teacher - physic specialist]

22/5/3 "I have cut down the amount of chemistry I do to a bare minimum".

[secondary teacher - biology specialist

When all these considerations are taken into account, there is clearly no simple answer to the question 'which topics are creating the most difficulty in teaching and learning science in forms 1-4?'

2.0 TOPICS IN GENERAL

We have considerable comment which refers to the three main areas of study: chemistry, physics and biology. These will be considered in terms of the four aspects of teaching and learning stated in the Introduction (page 1)

2.1 The difficulty concerns concepts

Most comment suggests that the concepts of the physical science topics are more difficult than those in biological topics.

25/20/2 "Conceptually the biological sciences are more straightforward. The concept area in the physical sciences - in physics and chemistry is much, much more difficult".

[HOD science, secondary]

23/12/2 "I find physics hardest to teach - to get across to them, they find it hard to understand physical concepts, much harder than biology and chemistry".

[3rd year physics teacher, secondary]

16/8/2 "Oh, Physics! I think just about everyone was confused in Physics.....it was mainly abstract ideas"

[ex-pupil]

17/4/2 "The kids are interested in chemistry because they are playing around with chemicals in test-tubes and bunsen-burners... in that aspect I think chemistry is good - it's just a game - I don't think they are understanding concepts and some of the concepts that these kids have grabbed hold of... it's incredible."

[HOD sec.science - chemistry specialist]

20/21/2 "In the more chemical type sections of the work - just a difficulty in understanding the concepts, there, perhaps because they're not so concrete".

[2nd year secondary teacher]

12/2/1 "Chemistry and Physics...I liked them but I couldn't do it - it didn't work out right - all those formulae and everything".

[ex-pupil]

12/2/2 "It was the mathematical part [of physics and chemistry] - I'm hopeless at maths".

[ex-pupil]

15/4/1 "I felt biology was easier because there was a lot of mathematical learning in physics and chemistry".

[ex-pupil]

7/4/1 "I just didn't seem to click onto it chemistry as easy as biology and Physics... it was mainly the formulae and having to work all the problems out".

[ex-pupil]

Although one can always find a comment against the trend

24/7/2 "I feel they like physical sciences - I am not sure why they like it. Perhaps the mystique of it... physical sciences, I think, are perhaps enjoyed also because there are a lot of things that you can manipulate and play around with. A lot of the Biological Science ideas, I think, tend to become a bit too abstract...in fact the easy subject you think of is in fact a bit more difficult".

[teacher with primary and secondary experience]

2.2 The difficulty concerns interest or relevance to pupils

Topics which are considered 'real' in the sense of being a part of the everyday world of pupils seem to generate fewer problems.

13/3/2 "If I had seen much more the practical applications of it, I probably would have enjoyed it more".

[ex-pupil]

13/5/3 "If we had done things in class that would relate to what happened everyday that would have made it a lot more interesting".

[ex-pupil]

Biology topics seem to be considered more often to be relevant than topics that are physical science based. Chemistry may suffer most in this respect.

12/6/1 "I enjoyed Bio more in the 3rd and 4th forms - it was more related to what I'd known whereas Physics wasn't, or Chemistry".

[ex-pupil]

22/5/3 "Chemistry seems to be what turns them off - a very close second is Physics".

[secondary teacher]

20/21/3 "When you get to sort of using chemicals that they have never heard of they have difficulty in coping with the name of the chemical let alone what it is".

[secondary teacher]

13/5/3 "Some of the things like light and how light travels - or even those heat things [looking at picture of a candle burning] you can apply it but not as directly as you can other things - like if you are studying biology and you learn how plants grow, well that's more interesting cause you can look out the window and see trees growing and you understand better".

[ex-pupil - now teachers college student - 1st year]

16/2/1 "Bio.was better...see in the environment there are things you can identify with - more than the physics side. "

[ex-pupil - now teachers college student - 1st year]

24/1/3 "We just used to write, write, write [in Chemistry] We never used to do things."

[5-Form pupil]

However it is not always Biology which comes off best:

20/2/1 "It may not hold with all ability groups but the low ability group that I had last year in the 3rd form were absolutely fascinated by the physics and chemistry sections - wouldn't give you a thank you for the bio."

[2nd year secondary teacher - Biologist]

2.3 The difficulty involves skill deficiencies

2.3.1 Language skills

We have had much comment relating to difficulties with the language of science. This has been in relation to both text materials and classroom conversation. The comments tend to be general rather than topic specific.

8/5/3 "I think there is a real language problem with kids. I think science because of its nature has got a lot of technical language and kids just get switched off by it".

[teachers college science lecturer]

36/2/1 "It would have been good if we had actually known what the words meant!"

[6-form pupil]

61/2/3 An observer after witnessing two 4-form students struggle to read aloud to the class from a text book (D.N. Hunt, Science for the 70's, p.14, Unit Studies in Science No. 9, 'Molecules large and small') asked the first reader:

Observer "When you were reading did you think you knew what it was about?"

Reader "No"

Observer "You weren't able to understand it? (laughter) Too many new terms or what?"

Reader "Yes - where did I read from?" [looks over passage again]

Observer "What are these thermosetting plastics? Can you remember about those?"

Reader "No - I wouldn't have a clue".

Chemistry because of the range of unfamiliar materials and the use of formulae and symbols is viewed by some as being especially difficult.

43/4/2 "All those shortened bits for words symbols - you can't remember them or anything like that".

[recent school-leaver]

20/21/2 "They have difficulty in coping with the name of the chemical let alone what it is".

[secondary teacher]

2.3.2 Mathematical skills

For some pupils the mathematical aspects of both physics and chemistry are a major problem.

13/3/2 "Biology is technical but not in the same degree of mathematical understanding and application [as in physics and chemistry]."

[ex-pupil]

15/4/1 "I felt biology was easier because there was a lot of mathematics learning in physics and chemistry... I did 6th form maths."

[ex-pupil]

22/6/2 "They seem to have an objection to doing any maths. or anything that way inclined - I think they have a fear of that quite often...maybe that is why we get on better with the biology...but when it comes to the maths in chemistry even that is very unpopular...and that is the case with bright kids too."

[secondary teacher]

20/4/1 "I still feel they are very poor on calculations... I think this modern maths. is not very helpful to their ability to cope with physics."

[physics specialist, secondary]

23/4/2 "They get very confused between the different terms and the different formulae [in physics sections]"

[physics specialist, secondary]

15/2/1 "It was trying to work out equations, and I used to get really sick of that and I didn't take anything in I don't think".

[ex-pupil]

25/8/3 "Many kids come through to 3rd and 4th form science - or to 3rd form science anyway, without the basic arithmetical skills to enable them to do some of the work that we have got to do"

[secondary teacher]

12/2/1 "Chemistry and physics, which is why I took biology, I just - I liked them but I just couldn't do it - it didn't work out right - all those formulae and everything... it was the mathematical part of it really!"

[ex-pupil]

25/8/3 "To some even simple arithmetic is very difficult".

[secondary teacher]

2.4 <u>The difficulty involves time, resources and/or conditions</u>

Many teachers consider lack of time a major constraint on what they can teach.

73/2/2 "We can't allocate the necessary time for science - they are trying to get us to teach too much perhaps".

73/2/1 "We just lack the time - the whole unit is just too involved".

[two comments from an experienced intermediate teacher]

9/13/3 "They were really good experiments if you could afford the time to set things up but when you've got another 9-10 subjects [topics] in the syllabus to get through.."

[experienced intermediate teacher]

17/1/2 "Having time to get everything ready for the particular unit - this is time to do this"

[HOD science, secondary]

Such comments are supported by pupils.

11/2/1 "One term you might be doing experiments on chemistry and physics and you just start to get to know what you are talking about and they change it and do biology".

[ex-pupil]

43/9/3 "We were rushing through too many things, and we weren't getting it sinking into us"

[ex-pupil]

However, some argue that lack of time is a self induced problem of the teachers - who tend to treat many topics in too much depth.

35/7/2 "I feel that it [lack of time] is very often a matter of people going much too deeply into a topic'."

[secondary science inspector]

34/4/3 "I think that [misinterpretation of the depth of treatment] is one of the problems with the current syllabus".

[secondary science inspector]

This may be because of the resources teachers use.

20/7/1 "If you look at the form 2 teachers' guide for ecology [Green Book - Biotic Communities] - I've sometimes used that as a basis for teaching form 6!"

[HOD science, secondary]

'Terminal predator' is a term emphasised in heavy print in the Green Book - Biotic Communities - this was one teacher's response.

27/7/3 "Things like 'terminal predator' for example, I think that was a particularly useless term.. I taught it because I thought well maybe next year they'll be expected to know it...not so much because I thought that particular piece of information is of real value for them".

[intermediate teacher with weak science background]

3.0 TOPICS IN PARTICULAR

Comments relating to particular biology topics are detailed in Appendix A. Overall we have recorded no comments relating to conceptual difficulties with specific biological topics apart from 'osmosis'. However, as our classroom observers noted, this does not necessarily mean that there are no conceptual problems present. Major criticism of the biology topics seem to relate to a certain redundancy between F1 and 2 and F3 and 4 topics.

As will be seen from Appendix B, physics topics can be difficult, and can create conceptual problems for many teachers and students. Many of the complications mentioned in the introduction relating to the problem of identifying 'difficult' topics apply to the physics topics. There is no clear consensus on particularly difficult or particularly uninteresting sections and no doubt there will always be divergent opinions. For example in the draft syllabus electrostatics has been removed. Two comments related to this follow:

34/9/2 "Electrostatics was obviously put in originally with the idea of enlightening kids as to what electricity is but I think the concepts are far too advanced and it causes confusion rather than enlightenment".

[secondary science inspector]

39/1/1 "Kids love electrostatics...I think [in the light of the new draft syllabus] what we will do is still do electrostatics".

[experienced intermediate teacher]

Perhaps syllabus interpretation and teaching methods can overcome most problems with topics as stated in the syllabus.

Appendix C details some comments about chemistry topics. Undoubtedly the unpopularity of chemistry in the past has related to the difficulty many children have had in visualizing atoms, molecules and chemical bonds. Where children can see something happening and can experience it and where chemistry can be related to everyday life there appears to be few problems.

34/8/1 "Coals, fuels, you see were O.K., burning of magnesium, great stuff, you know spots on the retina and all that sort of stuff... and it is exciting stuff...they can see something happening and they can experience it and it is the experience which startles them...it comes across...no problems with that".

[secondary science inspector]

Not all topics have been mentioned in the Appendix. Earth science, weather, animal way of life, have raised few comments from those we have talked to. However those comments we do have are generally favourable

provided ways have been found for the children to gain first hand experience themselves.

21/6/2 "[Man as consumer] that's good...the kids do enjoy it... they can see it relates to them...they can experience themselves, for example an activity relating to the heart rate...they are understanding themselves and that is one of the main aims of science... to understand the things around you".

[P.R. Junior Science]

WHERE DO WE GO FROM HERE?

One of our original ideas in the Learning in Science Project was to concentrate in the in-depth phase on particular 'problem' topics. Some of the difficulties of identifying such topics have been mentioned. If we do wish to limit our study in the in-depth phase to particular content areas [as against, or as well as, particular teaching methods or particular aptitudes, skills and attitudes] various possibilities must be considered.

In the light of the previous comments and in particular the specific information provided in the Appendix :

(i) Should we identify and study particular problem topics?
If so we must decide what type of problem we are interested in. Problems due to conceptual difficulties e.g. force and motion nature of matter; problems due to resources, e.g. astronomy; problems for teachers e.g. electrical energy(?); or problems for pupils, e.g. radiant energy (?)

(ii) Should we identify and study particular aspects of topics which are a problem?
We have already identified specific aspects of certain topics which are a problem. Words which have an everyday and technical usage [see FOCUS ON KNOWLEDGE], basic ideas of young children about light, osmosis, electric current and so on. Should our main interest in 'topics' be at this 'microscopic' level?

(iii) Should we identify and study particular problems - themes which occur over a number of topics?
Examples of possible problem-themes include; the use of symbols and equations in chemical topics, the use of mathematics in physics topics, the understanding of any science topic at the molecular level, e.g. nature of matter - the structure of compounds; plant way of life - osmosis; matter-diffusion.

(iv) Should we identify and study topics which are considered particularly successful?

The identification of the factors responsible for a topic being considered a success by both teachers and pupils, e.g. the trial mixtures unit mentioned in Appendix C, may be useful

Basically, in terms of the above questions, what do you think?

Appendix TOPICS IN PARTICULAR

A. BIOLOGY TOPICS

Generally student comment on the biological topics is favourable. Typical of these are

13/1/1 "I always liked the biology side better" [ex-pupil]

12/1/2 "Biology... I really enjoyed that at primary school" [ex-pupil]

Unfavourable comment suggests a response to what students perceive as repetitiveness with respect to the ecology section.

20/1/1 "I enjoyed it [science] in Form 1 but last year we seemed to be going over the same things we did in Form 1 and I started to get a bit bored with it... Biology was virtually the same" [3-former]

20/2/2 "lot of the stuff we are doing this year, [only biology at this time] I learnt last year" [3-former]

21/3/2 These two students come from schools in different parts of N.Z.

26/1/3 This feeling has been perceived by some secondary teachers, one of whom considers

6/20/2 "community organisation should not be in the 3 form syllabus - I've taken it out of mine" [HOD science secondary]

A secondary science inspector tended to feel that the problem had been aggravated rather than alleviated by the draft syllabus.

34/9/1 "The repetitive nature has been brought out more strongly and I think the reason for that is that it is actually stated that you should do an ecological study in F3 and F4, whereas in the old syllabus it was not stated...either the F1 and 2 content needs to be changed so that we are looking more at individual organisms rather than at communities, or the F3 and 4 content needs to be

34/8/3 changed so that they are doing that, my personal preference would be for doing that a F1 and 2"

Our limited observation of the teaching of Biotic community units in Intermediate schools has the topic being taught in considerable detail with the inclusion of considerable F3 and 4 material [e.g. Objectives 1a, 1c, 1d, 1e, 1g, 2a, 2d, 2e, 2g from Level 5 Section 2]

The only conceptual problem in biology that teachers have commented on has been 'osmosis'

21/2/1 "Osmosis is a difficult idea...they can see what happens but they can't really see it... kids will accept it while you talk about it, you then give them a different problem, a different approach to it and they might say 'osmosis' - but they can't really understand what is going on". [P.R. junior science]

However, although teachers do not identify conceptual problems, this does not deny that problems may indeed exist. As suggested by the example in

the Introduction to this paper there may well be misconceptions being taught which are not appreciated by the teachers themselves. Was it a 'once bitten' teacher who made the earlier comment about Biological Science?

24/7/2 "in fact the easy subject you think of is in fact a bit more difficult"
[primary/secondary teacher]

B. PHYSIC TOPICS

B.1 Radiant Energy

Typical comments are favourable both from teachers and pupils. It seems a high interest area and is activity-based.

39/8/3 "That is very well done and there is a very good module put out by the Department on that now"
[experienced intermediate teacher]

21/16/2 "Light - it really worked well, they were using the senior light boxes"
[secondary teacher - chem.specialist]

20/7/1 "Light - that was OK because they could actually do the work with the beams of light."
[secondary teacher - bio.specialist]

20/2/1 "The light - I could see how the light bends and things like that"
[3-former]

However, such comment is tempered by comments such as

21/3/1 "They are prepared to accept light when you talk about it as energy but whether they really understand light in terms of the energy idea - its pretty difficult to them".
[P.R. junior science]

13/4/1 "Oh most of the time we were just drawing the ray diagrams of what happened rather than seeing how it happened... I had great trouble understanding reflection, refraction and things anyway who wants to know what sort of lens produces what sort of light".
[ex-pupil]

These last comments relate to misconceptions that we have recently identified in many children's basic ideas about 'what produces light?' 'What happens to that light?' and 'how do we see objects?' [Work done by Beverley Stead]. We have also identified misconceptions in curriculum materials on this topic. [Draft syllabus support material for F1 and 2]

B.2 Forces and Force, Motion and Mass

This section poses many conceptual problems for both teachers and pupils.

22/5/3 "The ideas of Newtonian physics are just a bit too much, I think".
[secondary biology specialist]

39/9/3 "If you asked a physicist to look at what concepts were being developed I am not sure that he would say they were very good at all"
[experienced intermediate teacher]

21/7/1 "I sometimes wonder really how much is being attained in terms of an understanding of what forces are - since we can't even describe forces very well I am not surprised it is difficult to know whether the kids are understanding them or not...They probably get a reasonable understanding of the way in which forces act but they don't really...understand what forces are."
[P.R. junior science]

13/1/3 "The only thing we had which I didn't really understand was the physics sort of things...you know like the ball rolling up the hill and coming down...I just sort of got lost".
[ex-pupil]

21/17/2 "There is one concept I have found very hard and that is mass and weight....some kids very easily picked it up and some of the kids couldn't pick up the distinction"
[secondary teacher]

The apprehensions apparent in these statements seem to be not unwarranted in the light of our own study of children's concepts of force [see the Working Paper on FOCUS ON KNOWLEDGE]. Also the problem in these topics with respect to mathematics has already been referred to [see Section 2.3.2].

In spite of these conceptual difficulties some students have expressed enjoyment and achievement with this topic,

22/15/2 "[Did you understand the work with trolleys?] Yes I understood it, that was quite good, counting all the dots and using it with different masses and making graphs and things".
[5-former talking about 4F experiences]

15/10/2 "In the 4th form take the example of Kinematics - the way we did it was really good - we would take our ticker-tape and cut it up and make a graph out of it - that's what I remember and I learnt a real lot from that because it sort of showed you what you did...that was an incredibly good experiment"
[1st year Teachers College student]

Clearly some activities are very powerful but unfortunately they are often not appreciated.

12/8/2 "I can relate to biology more... to things around really... I mean things like in physics - how when we pushed something and it hits something off the end...well O.K. so it does it... well, so what?"

[ex-pupil]

B.3 Electrical Energy

As with Forces this topic holds conceptual problems for both teacher and pupil.

27/6/3 "I just knew absolutely nothing about any basic concepts of electricity".

[intermediate teacher]

23/12/2 "Electrical circuits for instance - they get right through to form 6 and they don't understand the difference between a series and a parallel circuit or why you put a voltmeter in series and an ammeter in'parallel'."

[secondary physics specialist]

21/4/3 "Electricity can be quite difficult...they seemed to understand the ideas pretty well but I didn't even mention electrons except to the kids that were asking about these things".

38/12/1 "I think that a lot of the kids that I have taught have found it very hard to grasp the concepts of electrical energy".

[intermediate teacher]

This section also places high demands upon resources and that can be a problem.

38/12/1 "There [Electrical Energy] we did have problems with equipment - no batteries, no wire and this sort of thing".

[intermediate teacher]

and resource material can creat problems.

24/6/3 "Offhand there were aspects of the Electricity book [Green book] which were absolutely ridiculous. A lot of the ideas were based on abstract thinking...for instance, there was one where they just have to work out the flow of electrons."

[intermediate teacher]

Our own observers too have noted teachers having difficulty teaching this topic [e.g. to 4 form pupils] due to a number of factors, not least their own inadequate understanding of the topic.

B.4 Astronomy

The main comments here are the problem of lack of opportunity for practical work and hence the difficulty of making it relevant to pupils.

21/4/1 "Some of the kids find this very interesting but others find that it is not very experimental and tends to be more project orientated and difficult to understand".

[P.R. junior science]

17/1/2 "The things they suggest are of the type that the teacher does in the classroom without the kids being able to do any practical or see anything".

[physics specialist with interest in astronomy]

There is also the problem of equipment,

17/1/2 "To be able to see anything in any detail the telescope needs to be of a quality that schools can't afford".

[physics specialist with interest in astronomy]

There is also, of course, the practical problem of night viewing.

However, the biggest problem may be a lack of resource materials.

39/7/2 "I think there is a great need for resource packs in both these areas Astronomy and Weather. They are poorly taught because teachers have to chalk and talk."

[experienced intermediate teacher]

21/4/2 "Textbooks are very out of date and any reference book is usually out of date and so information - it is difficult to find good information and in any one place so that there's a teacher problem with the unit more I feel than a problem with the kids".

[P.R. junior science]

39/8/2 "The unit is difficult because of the difficulty of relevance and the difficulty of the teachers getting enough resources to make a pretty good fist of it - to make it attractive to the pupils."

[experienced intermediate teacher]

And they suggest the kinds of resources they need -

17/1/2 "I know[named teacher] has a good slide collection - this is one way we could do it".

[physics specialist]

17/1/2 "I've used a recording of the moon-landing, it's 10 years old now and these kids know nothing about it - they sat glued for 20 minutes."

[physics specialist]

C. CHEMISTRY TOPICS

C.1 Matter, Nature of Matter

This topic is often mentioned as being difficult because of conceptual problems.

20/1/2 "...difficult for teachers to explain because you cannot get down to the right conceptual level".

[experienced primary teacher]
P.R. junior science]

20/22/1 "The concept of atoms was difficult because they couldn't see it....sure they could see the crystal, they could see it dissolve, they could see it regrow but what was happening to the atoms - oh gosh [laughs]".

[2nd sec.science teacher]

25/20/3 "Trying to convince a group of 13 year old kids that developing the idea of what happens inside this test tube because chemical reactions are an important set of changes that they should be aware of is pretty difficult. The test tube is real and it smells and what is going on inside it is real and it smells too, but when you ask people to take the smell and think about it in terms of atoms being rearranged and molecules whizzing around then you have got a bit of a problem.... The particle nature of matter and everything that stems from that, and it drives kids right up the wall."

HOD science]

34/6/3 "As far as I was concerned kids had no problems with the sorts of things that you can see in the test tube. They can see colour changes and reactions and precipitates and that sort of stuff grabs them.. they can handle it, they have no problems at all. It is when you start talking about the particles which cause the reaction to occur, or when you start talking about energy in the abstract sense of the term, immediately you can see the shutters going up... where everybody sits there and says yes sir, no sir, three bags full sir and you still see it happening in the classrooms today you know. I describe it as the death knell of the science lesson."

[secondary science inspector]

At the F1 and F2 level this topic is no longer a difficulty for those teachers who are following the draft syllabus.

39/8/2 "I would have said [prior to the draft syllabus] the particle nature of matter was one of the most difficult concepts to actually get across without actually telling the children - I think there are some kids that come out thinking that matter is made of little polystyrene balls".

[experienced intermediate teacher]

However for those following the traditional syllabus this is still a problem area.

72/3/1 "Some kids don't understand any of the particle nature of matter - they just don't see it at all."

[experienced primary teacher]

C.2 Mixtures

The only comments on this topic we have relate to the S.A.E.B. trial modules. These have received quite enthusiastic support from pupils - they like it, and understand it, because they do the activities themselves.

65/1/1 "Compared with most of the other subject that we are doing at the moment it the trial mixtures unit was one of the ones I enjoyed most. (Why?) Well I simply enjoyed it more, because there's a lot more activities involved".

[form 2 pupil]

65/6/1 "It was good, much better than our normal science units. (Why?) We get the chance to do the experiments this time and we get the chance to make up our own ideas and sometimes even our own questions".

[form 2 pupil]

The teachers trialling the unit also comment favourably -

38/4/1 "The organisation went pretty well - everything sort of went well - it was a good unit".

[intermediate teacher]